MAP Modeling and Assimilation

(GMAO Current Capabilities and Plans)

Michele Rienecker

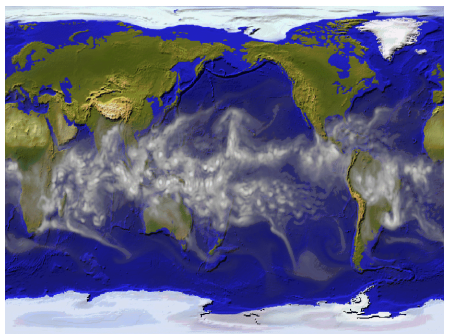
Global Modeling and Assimilation Office (GMAO)

And collaborators

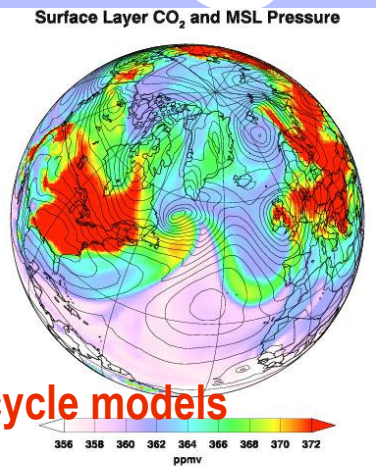
NEWS Science Team Workshop
September 7-9, 2005

MAP - Modeling Environment

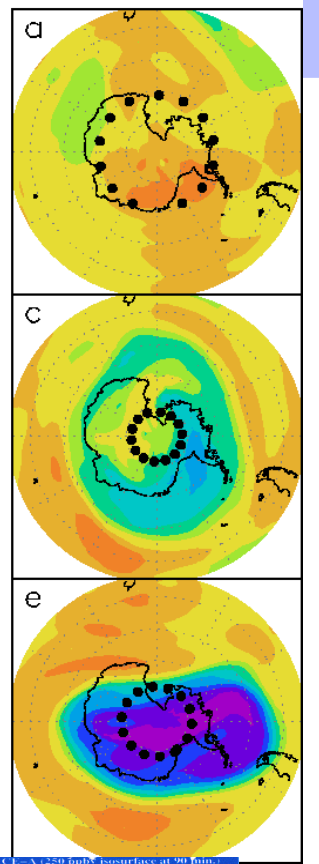
Earth System Modeling Framework



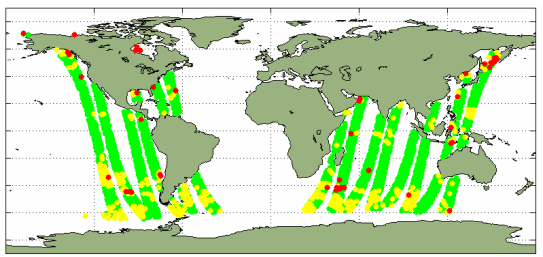
GMAO/GISS AGCM



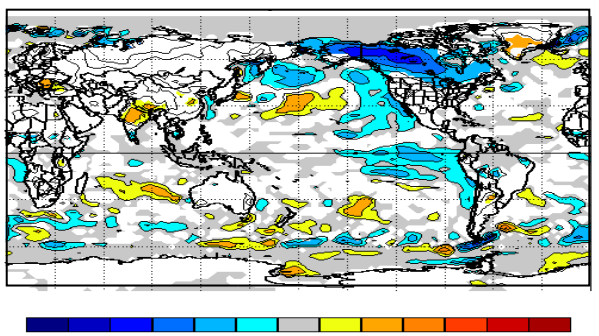
Carbon cycle models



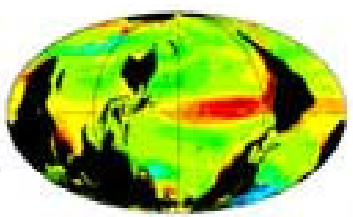
GMI



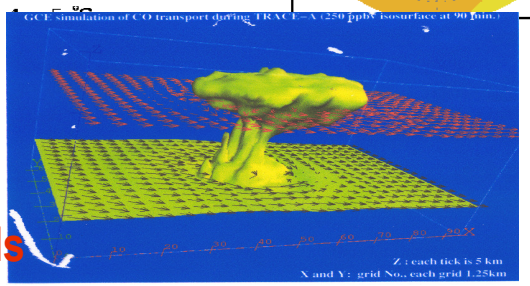
NASA/GSFC & NOAA/NCEP GSI



GMAO/GISS CGCM

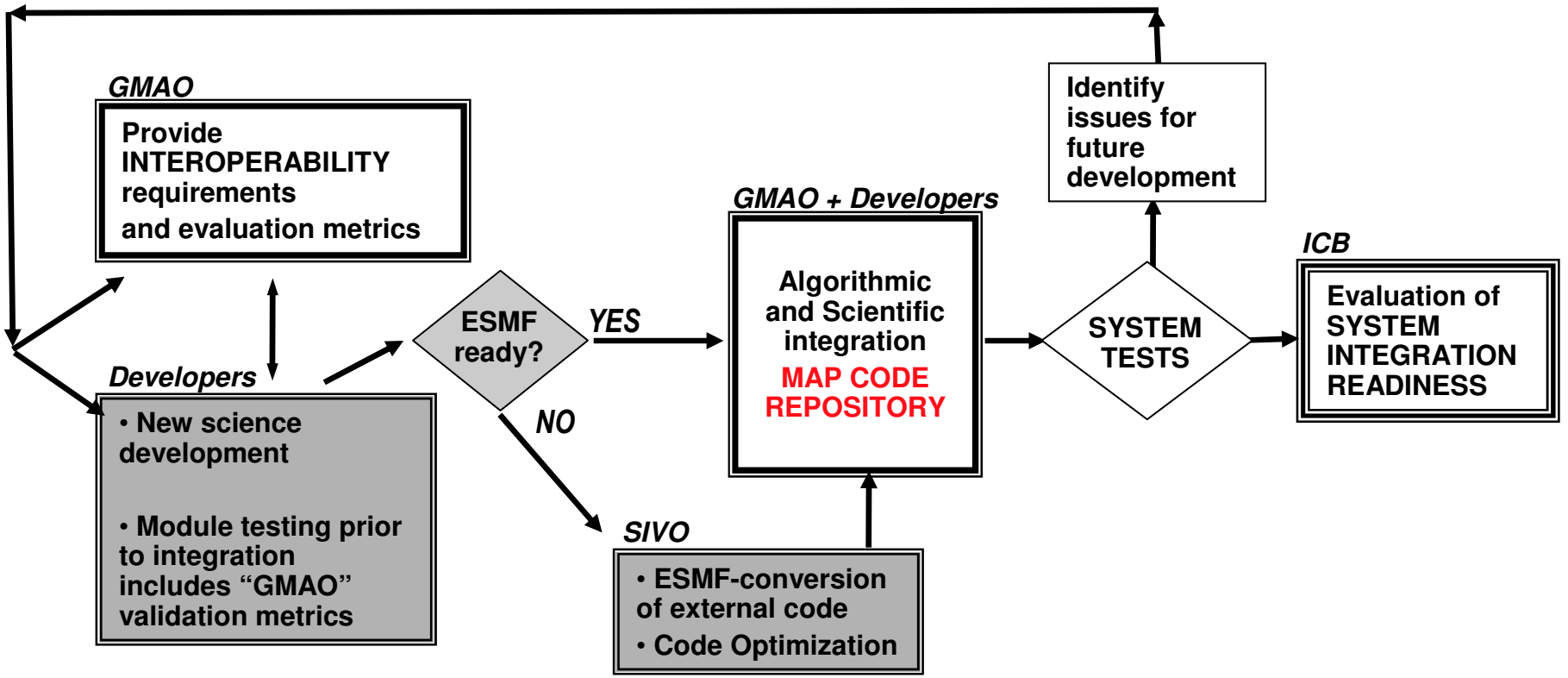


Poseidon/MOM/MITgcm



CRMs

MAP - Modeling Environment



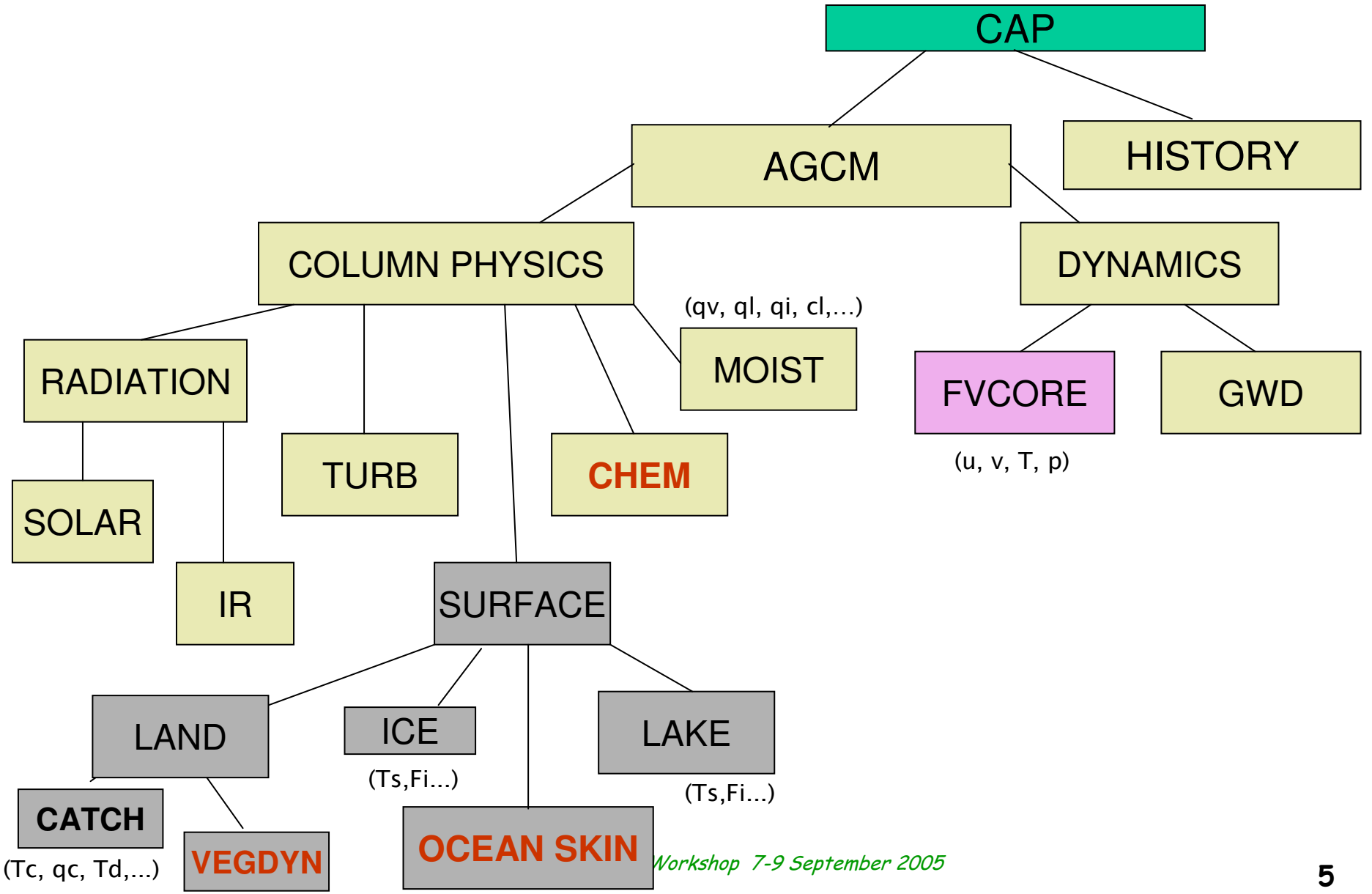
GMAO: GMAO developers and integration team
SIVO: MAP computational support group
ICB: Integration Control Board
Developers: Either internal or external developers, some ESMF experts, some not

MAP - Modeling Environment

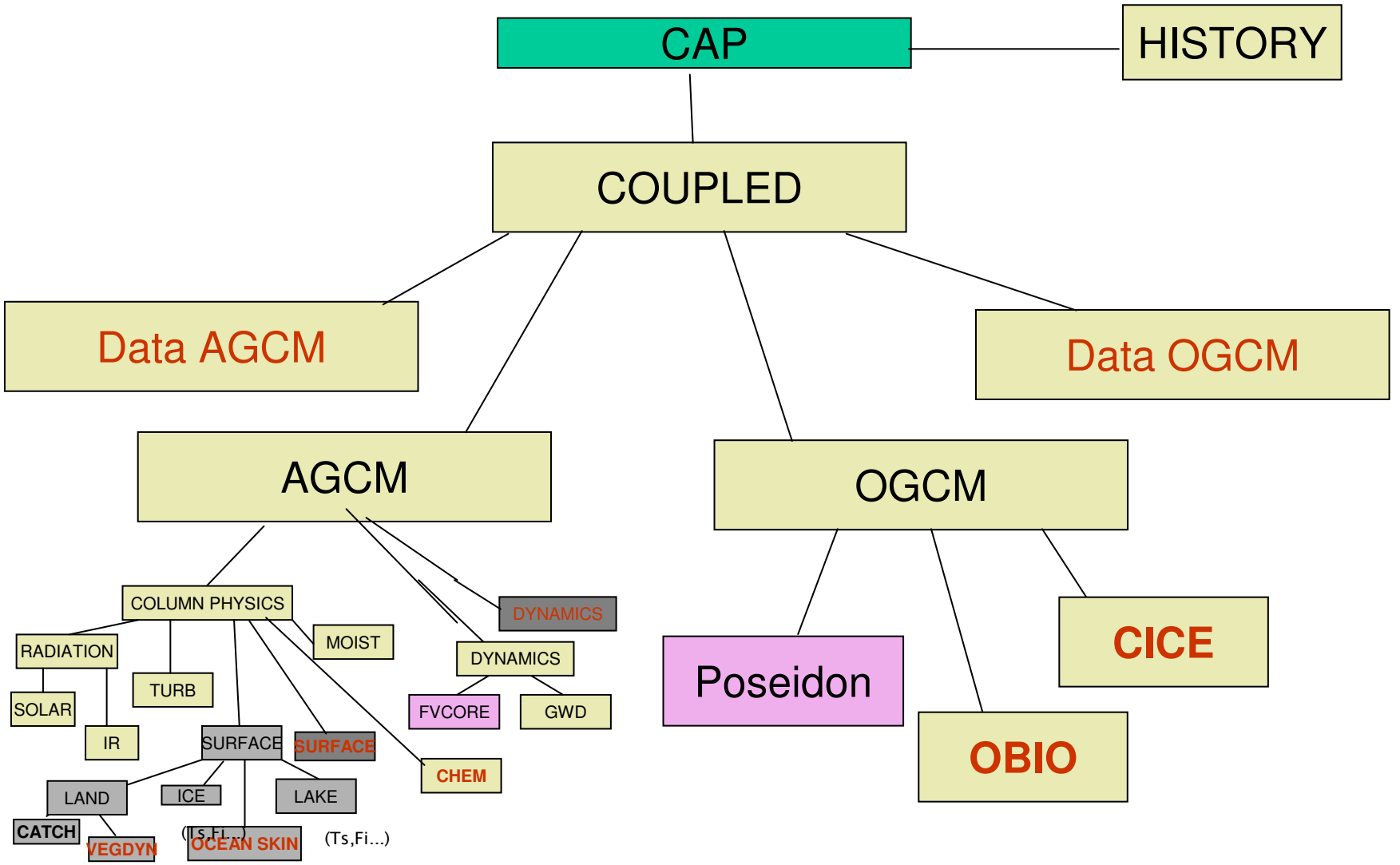
- SIVO (Head: Mike Seablom)
  - Advanced Software Technologies Group (ASTG)
    - Performance/Parallelization
    - Software engineering/design
    - Advanced scientific software - ESMF
  - State-of-the-art visualization tools and products
  - Provides shared software repository across modeling activities
  - Helps manage MAP resources

- GMAO
- GISS
- GMI
- Contributions from other SMD Focus Areas
- Collaborations

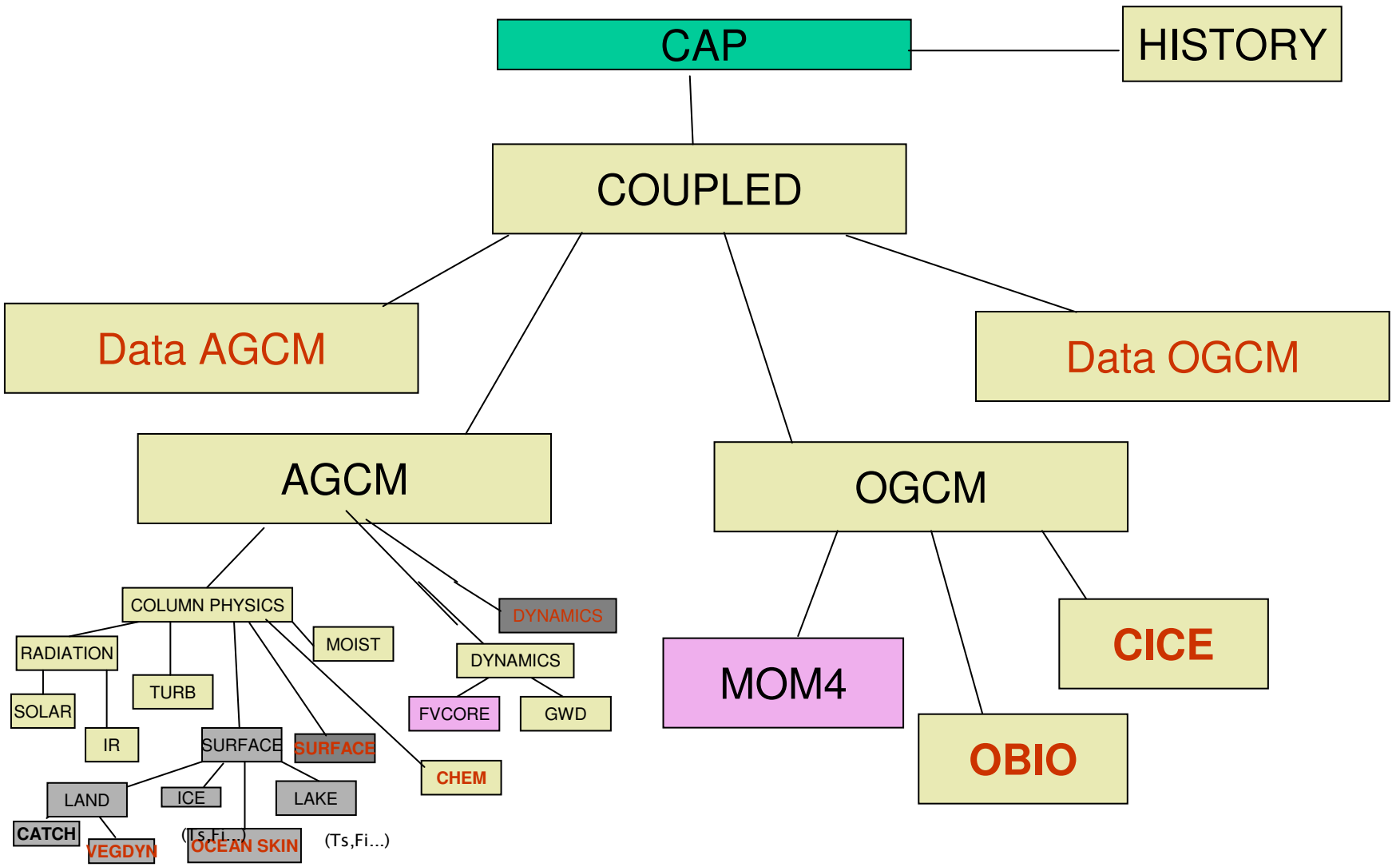
GEOS-5 AGCM COMPONENT STRUCTURE: ESMF



GEOS-5 COUPLED MODEL STRUCTURE

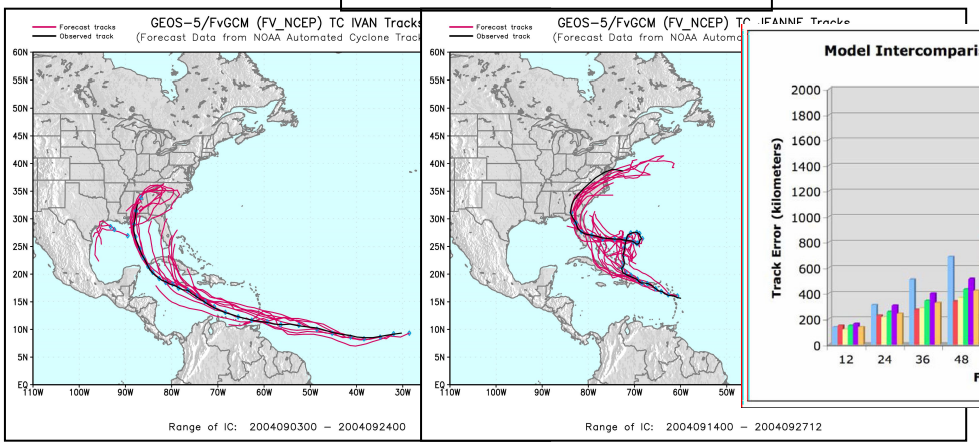


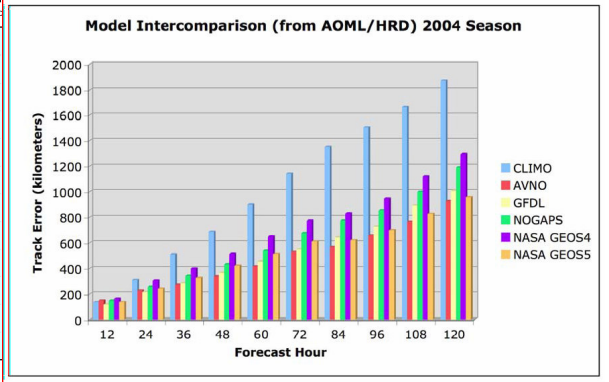
GEOS-5 COUPLED MODEL STRUCTURE



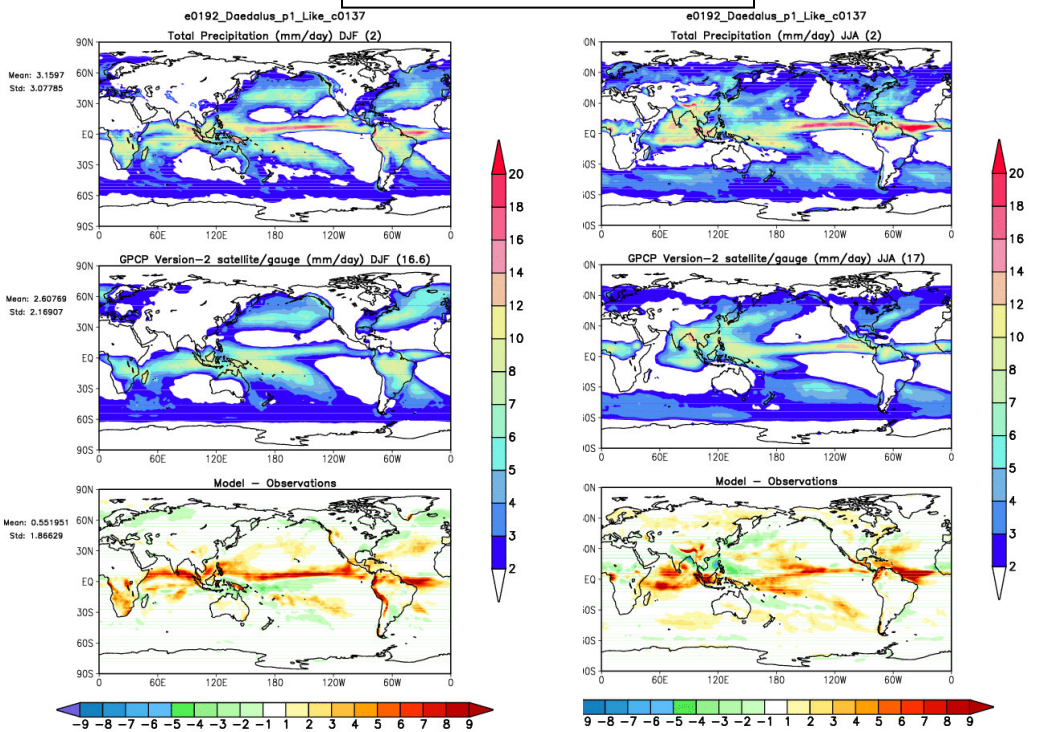
GEOS-5 AGCM TESTS

NWP mode - 1/4 degree

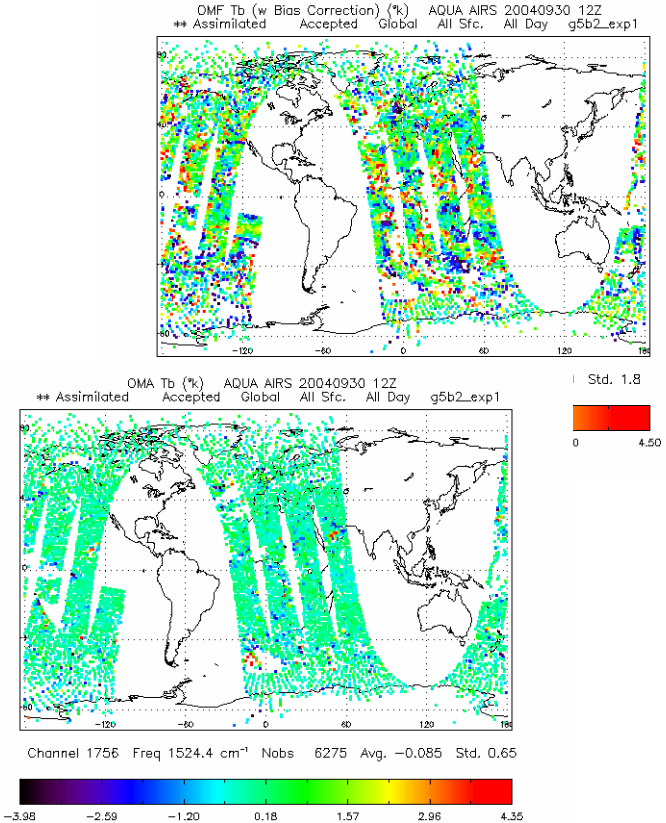




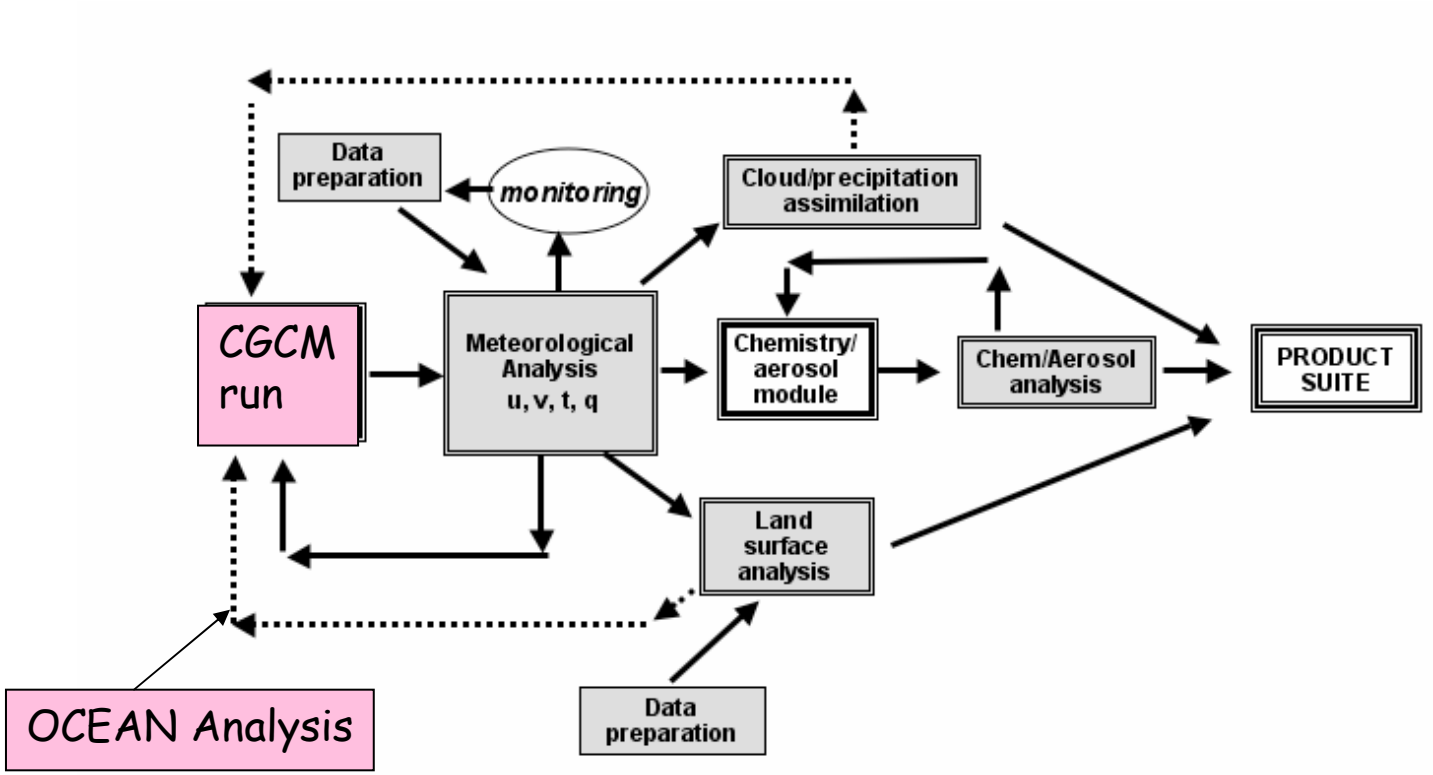
Climate mode: 1 degree

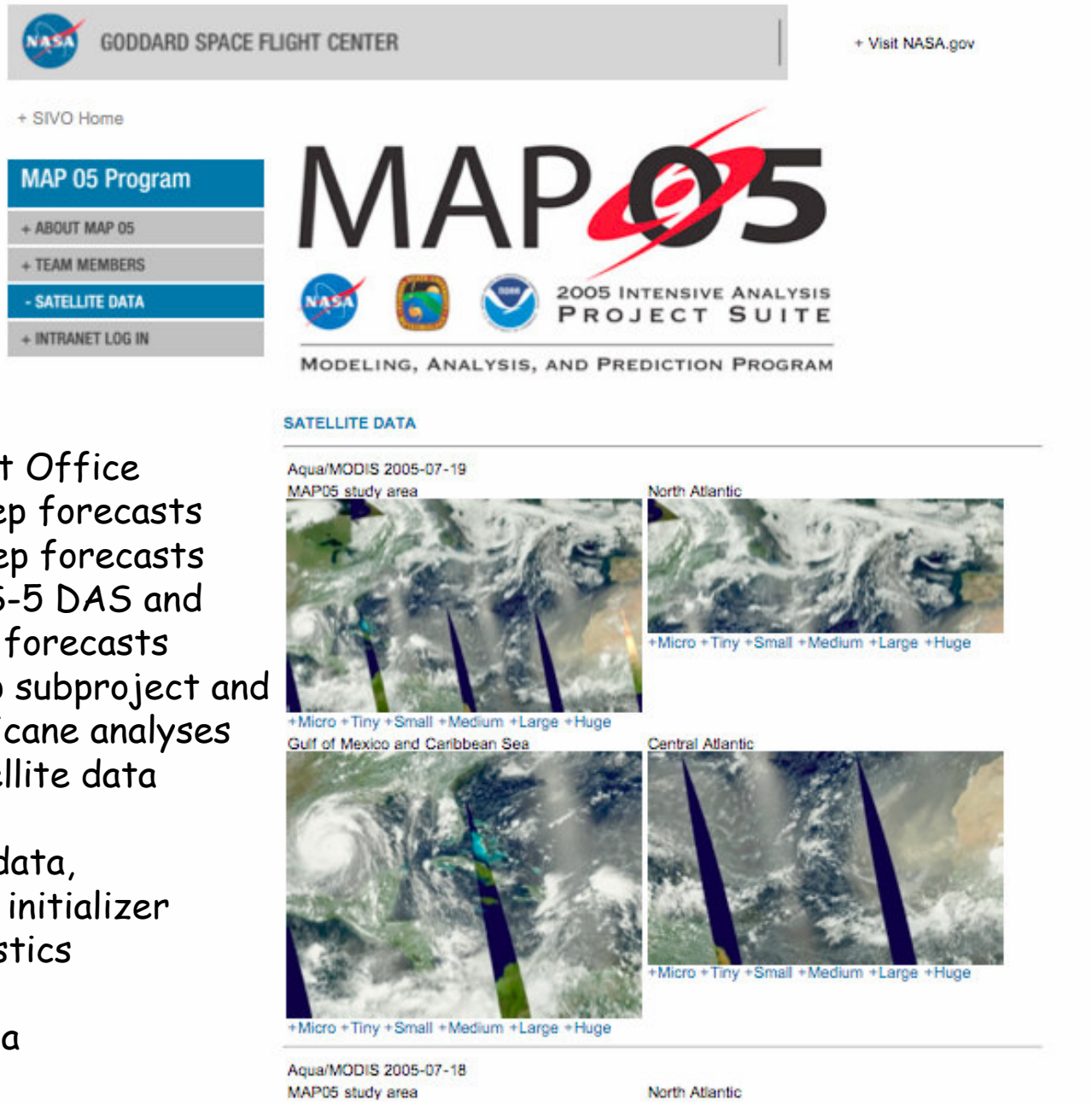


DAS mode: AIRS Assimilation



GMAO DAS


Data preparation
monitoring
Cloud/precipitation assimilation
CGCM run
Meteorological Analysis u, v, t, q
Chemistry/ aerosol module
Chem/Aerosol analysis
PRODUCT SUITE
Land surface analysis
OCEAN Analysis
Data preparation



SIVO - Project Office
GMAO - G4ncep forecasts
G5ncep forecasts
GEOS-5 DAS and forecasts
Atlas - G4ncep subproject and hurricane analyses
Feldman - satellite data

NCEP - initial data,
vortex initializer
diagnostics

NAS - Columbia

MERRA

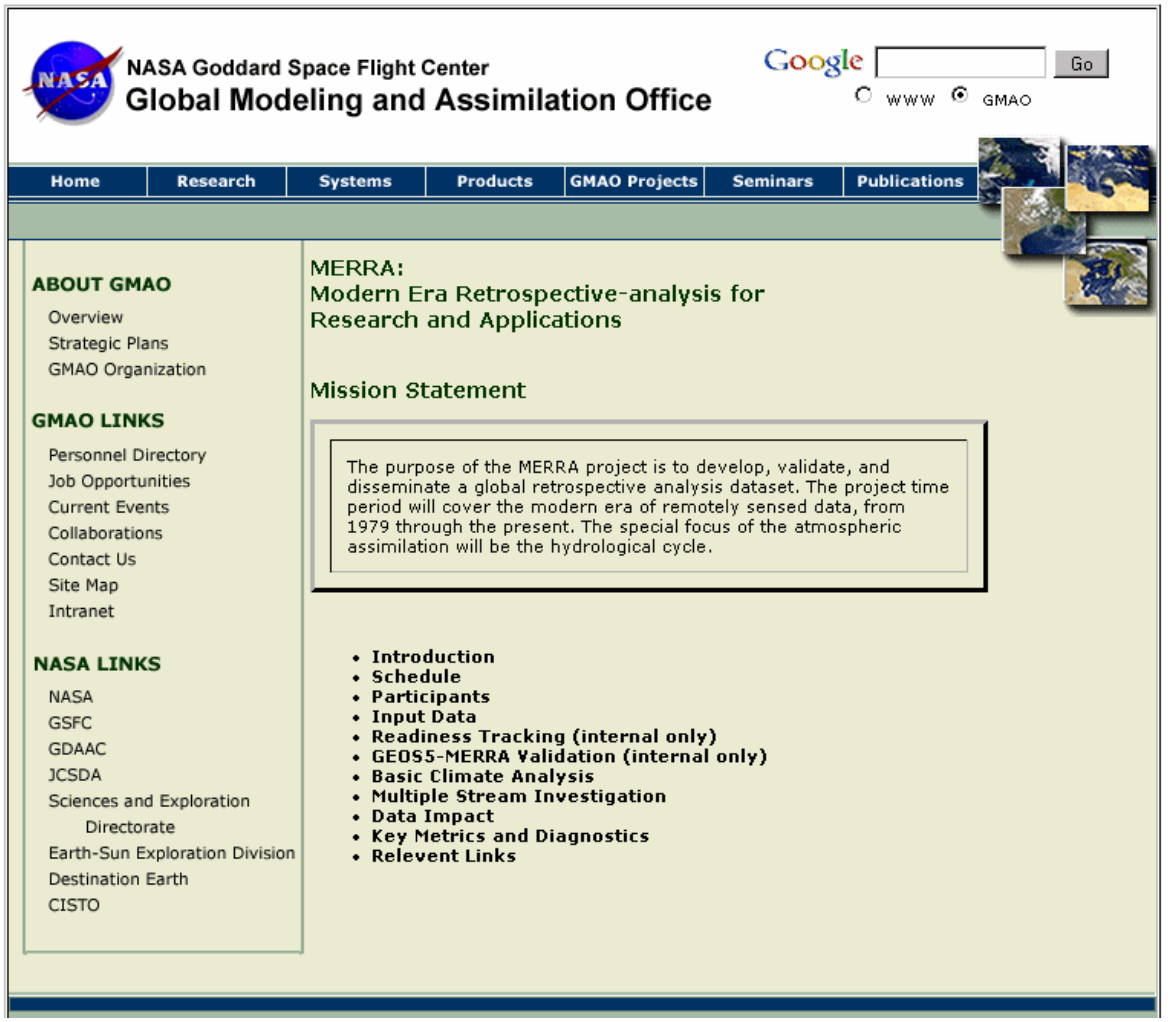
http://gmao.gsfc.nasa.gov/merra/

Michael Bosilovich, Siegfried Schubert & Gi-Kong Kim

MERRA Metrics for GEOS-5

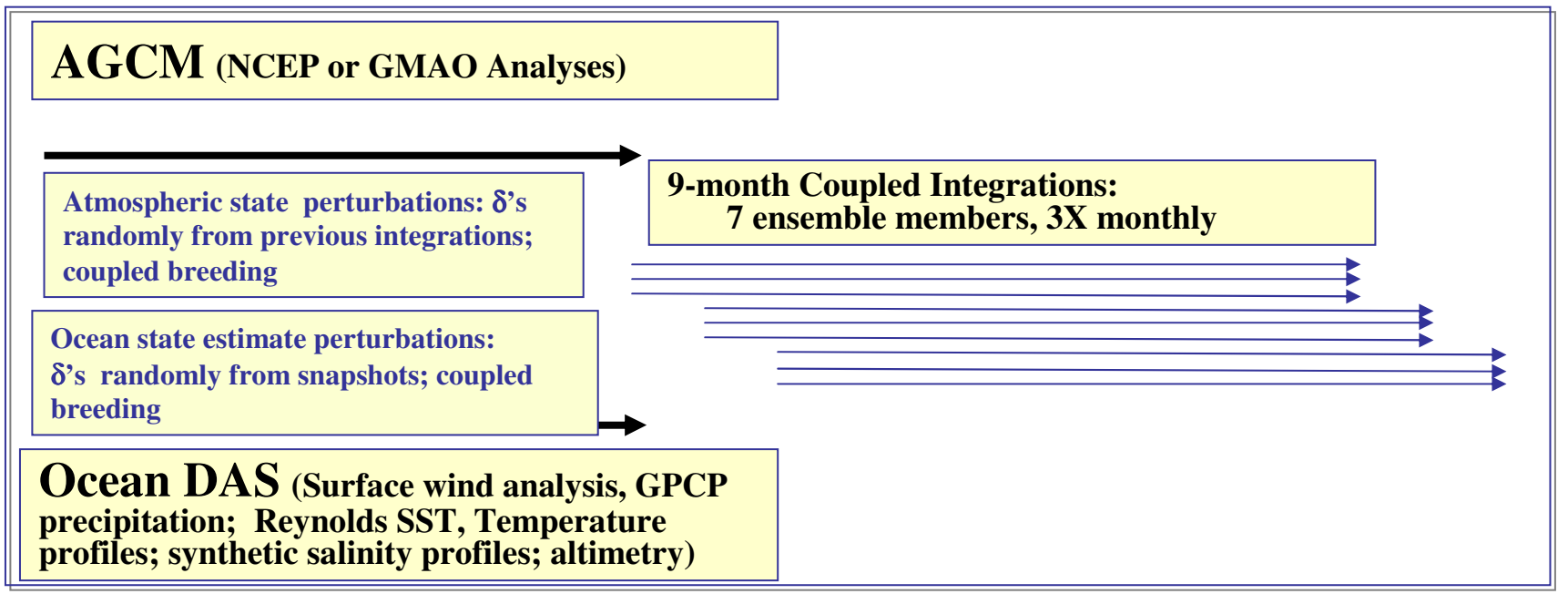
- WATER CYCLE
  - Global Precipitation, Evaporation, and TPW
  - Regional continental basin-scale budgets
  - Extreme events (drought, flood)

- DIURNAL CYCLE
  - Radiation, surface temperature
  - Precipitation



Next GMAO CGCM - GEOS-5

Subseasonal - interannual forecasts

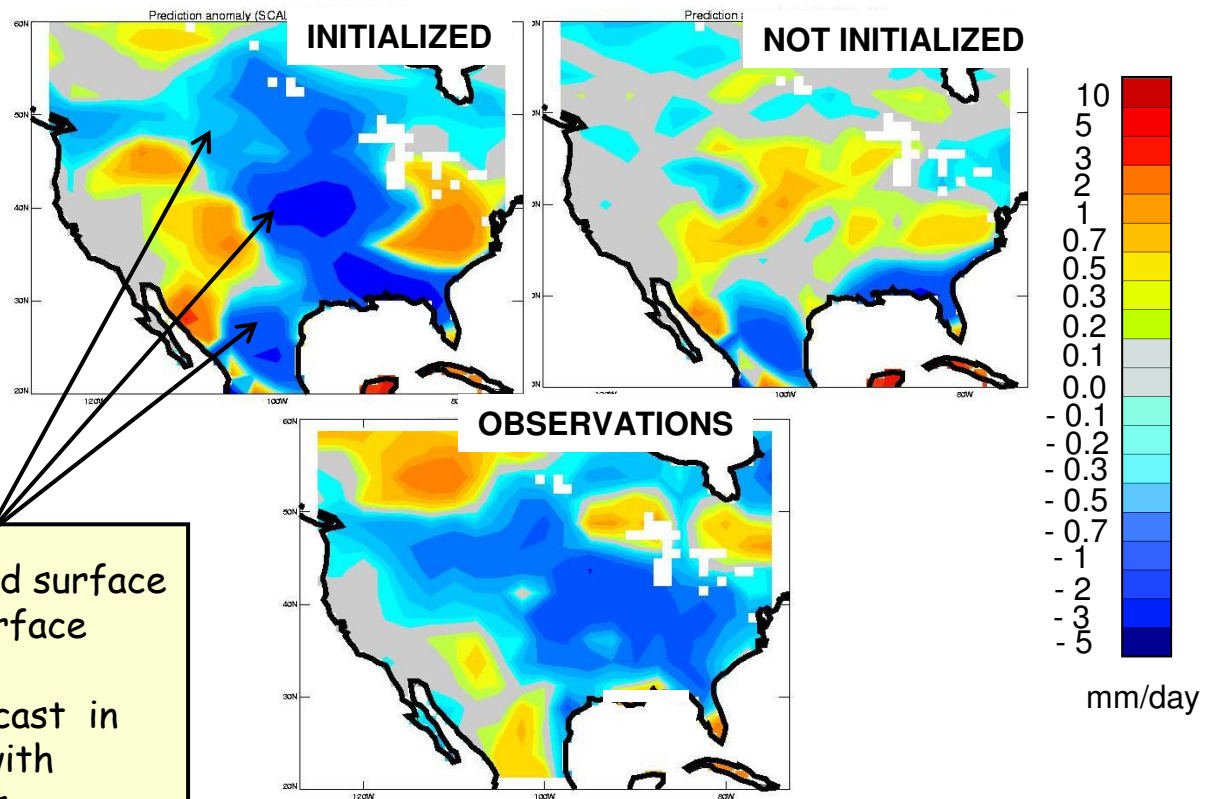


AGCM: GEOS-5 AGCM, 1 x 1.25 x L72
LSM: Catchment LSM
OGCM: Poseidon v5, 1/3 x 5/8 x L34
CGCM: Full coupling, 4X per day

ODAS: MvOI of *in situ* temperature, salinity profiles, altimetry; Ensemble Kalman Filter
"LDAS": Offline forced land states (recalibrated). EnKF

Land surface data improves summertime forecasts of precipitation
Initializing soil moisture - preparation for HYDROS

JJA Forecast precipitation anomalies: the 1988 drought



Initializing the land surface with corrected surface forcing improves precipitation forecast in areas consistent with theoretical results

Koster & Suarez

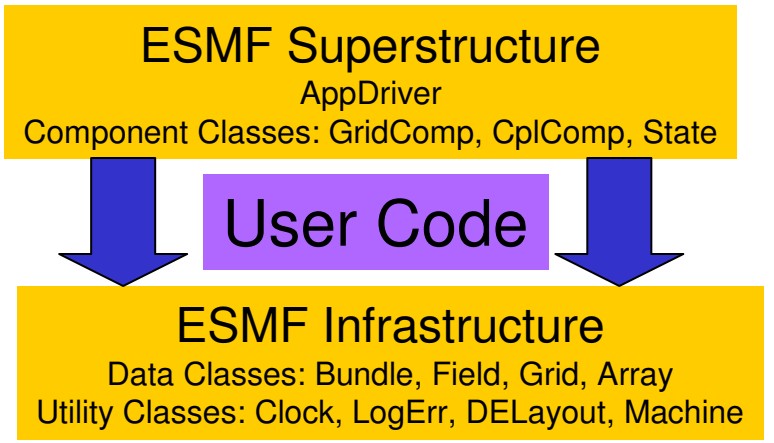
Planned Experiments:

- 1st year: 9-month hindcasts 1993-2006;
  - 7 members, 3 times/month, coordinated with NCEP
  - 1st, 11th, 21st of the month

- 2nd year: Limited retrospective forecasts 1967->
  - Forecasts with January starts
  - MOM4 included in ensemble

- Foci:
  - initialization of the coupled system - does breeding help? SV?
  - changes in predictability and/or forecast skill associated with changes in the ocean observing system, knowledge of surface winds, climate shifts
  - improvements in Ocean data assimilation
  - implementing Land data assimilation
  - contributing to CTB multi-model ensembles

What is the ESMF?



- ESMF provides tools for turning model codes into *components* with standard interfaces and standard drivers

- ESMF provides data structures and common utilities that components use for *routine services* such as data communications, re-gridding, time management and message logging